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Subject: Spruce Beetle and Hazard Tree Conditions at Snowbowl Ski Area (peaksrd)

To: District Ranger, Peaks RD, Coconino NF

At the request of Andy Stevenson (Silviculture) and Brian Tritle (Recreation), we (Joel McMillin, Mary Lou Fairweather, and John Anhold, Arizona Zone of Forest Health Protection) visited the Arizona Snowbowl ski area to evaluate damage caused by a recent wind storm. This letter summarizes our observations regarding the storm-caused damage to spruce-fir stands and its potential effects on future spruce beetle activity and hazard trees. We also provide information on previous suppression efforts to minimize spruce beetle impacts that occurred in response to a similar wind storm.

Background information

During the weekend of October 20 and 21, 2007, a wind storm occurred on the San Francisco Peaks including the Arizona Snowbowl Ski area. Wind speeds were clocked in excess of 84 mph resulting in uprooted and broken trees. Arizona Snowbowl personnel informed the Peaks Ranger District of the damage and suggested that an evaluation be conducted to assess the damage. Subsequently, Andy contacted us and arranged a site visit by our staff. Because spruce beetle is well known to infest windthrown trees (Holsten *et al*. 1999), there is potential for a spruce beetle outbreak following a wind storm such as this one.

Figure 1. *Wind-caused damage to Engelmann spruce at Arizona Snowbowl, October 2007. Left photo shows windthrow and right photo shows snap offs.*

Assessment of wind-caused tree damage

Our site visit consisted of aerial observations of damage by riding the Agassiz Chair Lift and then ground surveys from the top of the lift down to the Agassiz Lodge. Mary Lou and Brian examined trees directly adjacent to the lift, while John, Andy and Joel ran parallel survey lines in forested areas 50 to 500 feet from the lift.

Low levels of windthrow were observed above Midway (Table 1). Most of the windthrow was concentrated below Midway in the same general vicinity of the wind storm event that took place in 1999 (Figure 1). A general observation was that trees typically snapped above the root crown in closed canopy areas while windthrow (including roots) was more common in open areas. Although those snapping above the root crown often had advanced root and butt decay caused by tomentosus root disease, decay was not necessary for tree failure in areas that are open. Most of the damage occurred to Engelmann spruce, but a limited number of down corkbark fir were also found.

On separate visits to the San Francisco Peaks, Andy observed windthrow along the Humphrey's Peak trail and Mary Lou saw windthrow up above Little Springs (FS Road 418B) both inside and adjacent to the Kachina Wilderness.

Table 1. *Approximate number of wind-damaged trees adjacent or near the Agassiz Chair Lift identified in October 2007. These numbers are not inclusive of all areas at Arizona Snowbowl.*

	Above Midway	Below Midway	TOTAL
Spruce	50	125	175
Corkbark fir	--	25	25

Figure 2. *Advanced decay was present in many Engelmann spruce damaged during windstorm at Arizona Snowbowl. Tomentosus root disease was present in this tree.*

Root Disease

Both tomentosus and armillaria root disease were observed in downed trees. Tomentosus root disease was more common in downed trees that had snapped and failed above the root crown (Figure 2). Affected trees had advanced decay that often left only a cylinder of an inch or two thickness of solid wood remaining before the tree failed. A couple of these trees had previously

developed large vertical cracks that were likely created during the 1999 wind event. Armillaria root disease was observed in a few trees that had blown over by the roots, with advanced decay evident in some of the major roots.

Tomentosus root disease spreads primarily by root-to-root contact, although infection by spores can occur through deep wounds in roots. The fungus spreads both outward in roots and a few meters up into the butt of an infected tree. Decay from tomentosus is more advanced in larger and older trees, due to longer exposure and larger root systems (Lewis 1997). Blowdown of living trees due to tomentosus root disease contributes to spruce beetle activity, although less so after an outbreak has begun (Lewis and Lindgren 2002).

Recent spruce beetle activity related to windthrow at Arizona Snowbowl

In the fall of 1999, a wind storm caused damage to spruce-fir stands on the San Francisco Peaks. The majority of this damage (windthrow or breakage) occurred across 25 acres within the Arizona Snowbowl Ski permit area. Surveys in 2000 and 2001 indicated spruce beetle activity had occurred in essentially all the wind-thrown spruce. Several standing infested spruce were also found during a survey in the fall of 2001. These findings indicated that many of the brood developed and emerged within a one-year time span and most of the infested trees within the areas of blowdown; that is, beetles had not yet expanded to adjacent stands. Based on walk-through surveys, stands adjacent to the blowdown area seemed to be at moderate-high to high risk. There were numerous spruce trees greater than 16 inches diameter at breast height, and spruce composition and basal areas were high. This combination of stand characteristics and increasing beetle populations indicated that an outbreak was likely. In response to these findings a number of suppression strategies were implemented between 2002 and 2006 to minimize the amount of spruce beetle-caused damage.

2001. In 2001, the Peaks RD contracted with the Coconino Rural Environment Corps (CREC) to treat infested windthrown trees by limbing, bucking, and scorching the outer bark with torches. Due to the narrow window of favorable weather to complete this treatment, only a small percentage of the host material was treated.

2002. More than 700 infested standing spruce trees and new areas of blowdown were identified in late summer of 2002. In addition to surveying within the permit area, we ran a two-chain wide survey along the Kachina Wilderness boundary adjacent to the Upper Ridge ski run. Only eight infested spruce trees were found in approximately 8 acres surveyed, indicating that most of the infestation was still limited to the permit area. In 2002, the District contracted CREC to treat standing infested trees by felling and bark peeling through the use of a "log wizard." Removing bark causes developing brood to desiccate and die. Using log wizards permitted a wider window of opportunity for treatment compared with burning. However, because of delays in funding, chainsaw restrictions and forest closures, treatments did not begin until August and only approximately 150 trees were felled and peeled.

2003. In 2003, the Peaks RD also contracted CREC to treat standing infested trees by felling and peeling through the use of a "log wizard". From July through September, approximately 340 trees were felled and peeled. Funding delays and chainsaw restrictions due to fire risk prevented the felling and peeling treatments from starting until late July, and weather delays prevented the completion of treatments. In addition, infested trees adjacent to the Agassiz Chair Lift were not felled and peeled because of their potential hazard to the lift. Thus, some spruce beetle emerged

from previously infested trees before treatments took place, and not all infested trees were treated. In August 2003, personnel from our office identified 289 newly infested spruce trees within forest areas. Limited resources and time prevented other areas from being surveyed at that time. In addition to the felling and peeling treatment, the anti-aggregation pheromone for spruce beetle, MCH, was deployed on approximately 50 acres of forested area within forested areas. The use of these pheromone treatments and treatment of infested trees reduced new attacks by an estimated 75 percent.

2004. In 2004, the Peaks RD contracted CREC to create trap trees, treat standing infested trees by felling and peeling, and deploy MCH bubble capsules. Because not all infested trees near the chairlift were felled, and because several factors prevented infested trees from being treated prior to beetle emergence in past years, the additional treatment of using trap trees was implemented. Trap trees are uninfested trees with a diameter at breast height (DBH) greater than 12 inches that are felled before beetle flight initiates in the early summer (Holsten *et al*., 1999). Trap trees can absorb up to 10 times the number of spruce beetles that a standing tree will absorb and can help to suppress increasing spruce beetle populations (Bentz and Munson, 2000). In May 2004, 12 clusters of five trap trees (60 trap trees in total) were created by selecting uninfested spruce trees within in designated areas. The 60 trap trees plus 87 current infested trees were felled and peeled by CREC crews. An additional 18 trees were felled and peeled along the Agassiz Chair Lift with the assistance of Arizona Snowbowl staff. In addition, all stumps were peeled as they can harbor large numbers of spruce beetle. The combination of treatments further reduced new attacks, and spruce beetle populations as a whole diminished within the Arizona Snowbowl permit area.

2005. In 2005, similar treatments were implemented using the CREC crew; however, instead of using trap trees, Lindgren funnel traps (Lindgren 1983) were placed within forested areas. These traps were used to monitor the timing of spruce beetle flight and collect emerging beetles from trees not treated in the previous year. Traps were hung on string between old infested trees to minimize the amount of spillover (term used to describe beetle-attacked trees adjacent to baited pheromone traps). A total of 51 beetle-infested spruce trees were treated by feeling and peeling in September 2005.

2006. In 2006, similar treatments (MCH, felling & peeling of infested trees) and beetle flight monitoring (funnel traps) were implemented using the CREC crew. A total of 18 infested trees were identified, cut, and peeled. In addition, 10 pairs of funnel traps were placed along the Boo Boo, Bambi, and Lodge Run ski trails in stands that were predominately corkbark fir and aspen. These areas were selected for trap placement to minimize the potential for spillover-attacks and to use a location that was more distant from the MCH treatments. All spillover trees within 150 foot radius of traps were identified, felled, and peeled in October 2006. A total of 17 spillover trees were treated by peeling of which only 5 trees were greater than 10 inches DBH. At the end of the 2006, it was decided that no further actions were necessary in 2007 as spruce beetle populations had returned to endemic populations.

Hazard Trees

Our staff was requested to conduct hazard tree evaluations and a training session at the Snowbowl Ski area in 1996 and 1998. In 1998, we identified 77 trees around the Agassiz chairlift (between Tiger and Midway) as having enough defect to cause failure and potentially hit the lift (Letter on file 2000). Seventy percent of these defects were due to advanced stem decay,

and approximately 10 percent were due to root decay. The identified trees were removed that year. The big blowdown followed the next fall (1999) within the same general area, supporting the idea that we can only attempt to reduce hazard tree potential with our exams.

Recommendations

Spruce beetle can severely impact many forest resources and have the potential to kill up to 90 percent of spruce basal area and more than 70 percent of trees per acre in a stand over the extent of an outbreak (Dymerski et al., 2001). As mentioned previously, because spruce beetle is well known to infest windthrown trees, there is potential for a spruce beetle outbreak following a wind storm such as this one. Therefore, we recommend treating all windthrown and broken trees plus any standing infested trees. Felling and peeling treatments should take place in September through October. The reasoning for this is that both fire danger restrictions (typically early June through early July) and weather delays (mid July through early September) can hamper treatments from efficiently being implemented during most of the summer. Although spruce beetle populations are currently at low levels, we expect much of the down trees to become infested during the summer of 2008. Use of log wizards to peel infested host material on the ground and any standing infested trees should work to prevent a population increase of spruce beetle within the Arizona Snowbowl area. It is important to peel the stumps of broken and uprooted trees as this host material can harbor large numbers of spruce beetle.

Storm damage outside the boundary of Arizona Snowbowl may result in population increases in those areas. We will monitor populations and damage through our aerial detection surveys and follow up ground surveys as needed. Funds may be available for FY2008 from Forest Health Protection for preventing build up of spruce beetle populations in the recent blowdown material at the Snowbowl Ski area.

Hazard tree risk along the Agassiz chairlift has likely decreased over the past 8 years due to the blowdown of trees with advanced root decay and removal of bark beetle infested trees, both of which brought weakened trees to the ground when risk of injury was not probable. Although the majority of trees in the area of the Snowbowl are relatively young spruce trees, there are pockets of older spruce and aspen trees adjacent to chairlifts and ski runs that have the potential to fail. Our staff is available to work together with the District and/or Snowbowl on hazard tree assessments.

If you have any questions regarding our assessment of current bark beetle activities within the project area, its potential effect on residual standing trees, or recommendations, please let us know. Joel can be reached at (928) 556-2074 and Mary Lou at (928) 556-2075.

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